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Water Is Life

Questions to consider

- ① Why is water important?
What is the hydrosphere?
- ② What are natural resources?
What are aquatic resources?
- ③ How do we use water? How much water is available or human use? What is conservation? Why is it important?
- ④ What are the special properties of water? Why are they important?
- ⑤ How can we tell if water is polluted or clean? How does water pollution affect aquatic life?
- ⑥ How does water's temperature affect the amount of oxygen in it?
- ⑦ What is water quality? How do humans affect water quality?

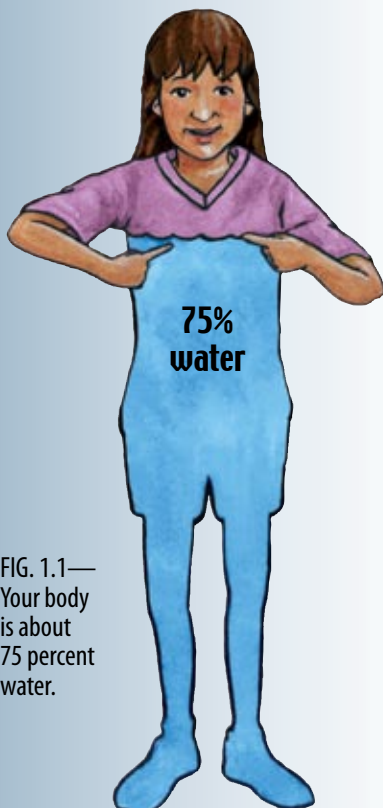


FIG. 1.1—
Your body
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75 percent
water.



FIG. 1.2—Most of the water on Earth is too salty to drink or is frozen.

Did you know that every living thing—plants as well as animals—is made up mainly of water? Your body is about 75 percent water. (FIG. 1.1) All life forms (even humans) need clean water to keep them healthy. In fact, without clean drinking water you would die in one week. Our need for water links us to the past and to all living creatures. Since ancient times, societies have succeeded or failed according to their ability to get clean water. Today's modern cities still depend on water for everything from flushing toilets to making automobiles. Your community depends on water, too. Making the best use of water is critical to our survival. We can't live without it!

A water molecule is two hydrogen atoms and one oxygen atom joined together. That's why we call it H_2O . At this moment, the Earth has all the water it has ever had or will ever have. This is because water is a **natural resource**. It can't be made in a factory. Water and all things that live in or around water are called **aquatic resources**. The **hydrosphere** is all the water on Earth. Water covers about 71 percent of Earth's surface. That's about 358 quintillion (358,000,000,000,000,000) gallons of water! But 97 percent of the world's water is too salty for humans to drink.

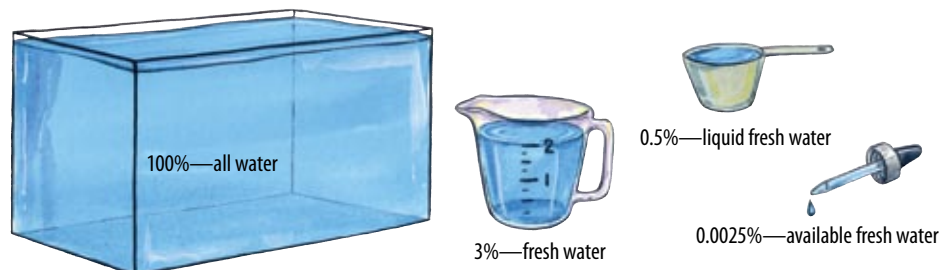


FIG. 1.3—Less than one half of one percent of Earth's water is available for use. Like all earth's materials, it is a limited natural resource affected by human activity.



FIG. 1.4—On average, every American uses about 90 gallons of water a day.

How much is enough?

That leaves 3 percent to supply the whole world with fresh water. But 80 percent of fresh water is frozen in the polar ice caps. (FIG. 1.2) All but one-half of one percent of what's left is too polluted to use, trapped in soil or just too hard to get. (FIG. 1.3) That leaves only about two million gallons of water per person. Sounds like a lot, but if you used 150 gallons every day, you'd run out of water before your 40th birthday! Luckily,

water is also one of the most recyclable substances on Earth. In fact, all the water on the planet has been recycled countless times—we drink the same water the dinosaurs drank! So when we use water, we don't destroy it or make it disappear. We move it or make it unusable—sometimes for a few minutes and sometimes for a few million years.

A person can live on a gallon of water a day for drinking, cooking and washing. But most people use far more than this. On average, every American uses about 90 gallons of water a day. (FIG. 1.4) Worldwide the need for water has tripled over the past 50 years. To have water to use, we have drained rivers dry, turned grand valleys into huge tubs and pumped so much water out of the ground that the Earth's surface has sunk beneath our feet. In the United States, we often take for granted the water that flows out of our faucets. We assume our



FIG. 1.6—The Mississippi River is an important highway for moving goods through the nation.

water is safe. We don't think much about where it comes from, how much we use, or what happens to it when it swirls down the drain.

Waste not, want not

The United States is water rich. We have 39,400,000 acres of lakes and **reservoirs**. The Great Lakes cover about 6,727,000 acres and contain about one-fifth of the world's fresh water supply. Water covers about 4 percent of the United States. This abundance has allowed the United States to grow surplus crops and build profitable industries. Everyone uses water, but it may surprise you to learn that homes and cities use only about one-tenth of the total water used. Agriculture is the biggest user of water. (FIG 1.5) For example, it takes about 24 gallons of water to grow one pound of potatoes. To produce one pound of beef takes 2,607 gallons of water! Growing a day's food for one adult takes about 1,700 gallons of water. The second biggest use of water is for industry. Producing electrical power takes more water than any other industrial use, but almost all of it is returned to or never removed from its source.

Missouri has 1,163,000 acres of fresh water, covering about 2 percent of the state. Part of this water is in 112,000 miles of streams. Another 276,708 acres are in public lakes and about half a million acres are in small private ponds. Our underground water resources also are vast. The state bubbles with a thousand springs, including some of the largest in the world. Our state also has one of the greatest varieties of freshwater fishes in the nation. Missouri



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FIG. 1.5—Agricultural irrigation is by far the biggest use of water in the United States.

waterways provide homes for over 200 kinds of fish. Hundreds of thousands of geese, ducks and other migratory birds use Missouri's waters, too. Raccoon, beaver, muskrat, mink, river otters and other mammals depend on Missouri's aquatic resources. The two largest rivers in the United States—the Mississippi and the Missouri—flow through our state. These big rivers provide water for personal use, transportation and industry. They also give us opportunities to enjoy fishing and just being around water. (FIG. 1.6)

If our nation and state are so rich with aquatic resources, you may be asking why we need to study them and conserve them. The answer is that people harm rivers, streams, lakes, ponds, swamps and marshes by **pollution** and careless use. To protect our vital aquatic resources, we must use them wisely. **Conservation** means careful use. That is what this book is all about.

What's so special about water?

Water can take three forms: liquid, solid (ice) and vapor (steam). (FIG 1.7) Water can travel great distances, climb up tubes, keep animals and plants alive, break rocks and dissolve almost anything. Water's chemical structure gives it these amazing



FIG. 1.7—Water is the only substance on Earth that exists naturally in all three states—solid, liquid and gas.

powers. Water molecules attract one another in a way that makes them form drops. Have you ever watched raindrops creep across a window? When the droplets get close to each other, they join to form one larger drop. Water's strong attraction to itself creates surface tension that allows insects such as the water strider to walk on it without breaking through. (FIG 1.8) Water molecules cling to other things, too. This clinginess allows water to climb up plant roots and enables blood to flow through tiny blood vessels.

Water has a high boiling point of 212° F and a low freezing point of 32° F). Water can absorb a lot of heat before it begins to get hot. A large body of water heats up very slowly, and it cools down just as slowly. This property allows living things to survive in a fairly constant environment. Water is unusual because its solid form (ice) is not as dense as its liquid form. This is why ice floats. Without this property, lakes would freeze solid, trapping and killing fish and other aquatic life.

Water is very good at dissolving many different things. For this reason, water in nature is never completely pure. It contains **dissolved oxygen** and other gases from the air and dissolved minerals from the Earth. These gases and minerals allow aquatic animals and plants to live and grow under water. Unfortunately, the gases, minerals and other things that water dissolves also can pollute it. **Water pollution** occurs when too many natural or man-made substances get in the water. These substances can harm or kill the plants and animals that live in or near the polluted water.



FIG. 1.8—Water striders take advantage of surface tension to walk on water.

Pollution kills

Pure water is clear—transparent to light. This means that as long as it is relatively clear, plants can live under the water, using energy from sunlight to make food through photosynthesis. Cloudy water contains more suspended material, such as mud. Few plants grow in muddy water because the silt absorbs light. But not all clear water is clean.

Water may look clean but still be polluted. A body of water may have toxic (poisonous) chemicals in it. Most toxic pollution comes from man-made herbicides, pesticides and industrial compounds. Another kind of pollution we can't see is too much heat. Hot water holds less oxygen than cool water. All living things, including the plants and animals that live in water, need oxygen. Rainwater running off a hot asphalt parking lot after a summer storm can dump hot water into a stream, killing everything in it.

Organic pollution occurs when too much organic matter, such as manure or sewage, gets in the water. The decaying organic matter uses up a lot of oxygen. Organic pollution can also happen when **inorganic** pollutants such as nitrates and phosphates build up in the water. People use nitrates and phosphates as fertilizers because they help plants grow. High levels of these plant nutrients in the water feed the growth of plants and algae. Too much plant growth at the surface can block light from reaching deeper water. Then as the plants and algae die and **decompose**, they use up the supply of dissolved oxygen. The process of rapid plant growth followed by rotting and oxygen loss can result in the death of fish and other animals in the pond.

Quality water means quality life

The amounts and types of pollution in water affect its **water quality**, which is its fitness for a particular use. Untreated water might not be pure enough to drink, but it may be just fine for swimming or fishing. Many things affect water quality. Physical properties such as cloudiness and temperature make a big difference. Chemical characteristics also change water quality. Water-quality tests check the water's acidity and how much electricity it will conduct. By measuring water's ability to conduct electricity, you can tell how much salt and other substances are in the water. These tests also measure the amount of dissolved oxygen and detect the presence of chemicals such as fertilizers. The presence or absence of plants and animals in body of water indicates water quality, too. If you find a wide variety of healthy **aquatic organisms**, including plants, insects and fish, you can bet that the water quality is high.



KORPADOL PACHONG

Water resource regulators keep water clean

The federal **Clean Water Act** was passed to protect our water resources. Water resource regulators enforce the Clean Water Act. They work for agencies such as the U.S. Environmental Protection Agency and the Missouri Department of Natural Resources. They enforce water laws and rules and penalize polluters. Environmental compliance officers monitor water pollution. They make sure industrial and domestic waste treatment systems are following the rules. They test water quality and collect water samples for chemical and biological analysis. These jobs require a college degree in science.